2000

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Upjohn Institute Working Paper No. 00-63

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Upjohn Institute Staff Working Paper No. 00-63
Kalamazoo, Michigan: W.E. Upjohn Institute for Employment Research, 2000

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September 2000

I greatly appreciate the research assistance of Ken Kline, and the secretarial assistance of Claire Black and Nancy Mack. This project was financially supported by the Upjohn Institute, the Russell Sage Foundation, and the Rockefeller Foundation. The findings and conclusions of this paper are those of the author and may not reflect the views of the project's sponsors.

Abstract

Using panel data on U.S. MSAs, this paper estimates how a typical MSA's wages of different demographic groups, and prices, are affected by overall MSA unemployment, the distribution of unemployment among different groups, and national prices and wages. MSA unemployment has strong effects on MSA wages and prices, but the distribution of unemployment among different groups has weak effects on wages and prices. Using these estimates, simulations show that targeting high-unemployment groups for unemployment reductions will not reduce wage or price inflation pressures. The estimates also show that the effects of MSA unemployment on prices and disadvantaged groups' wages are greater (in absolute value) at lower unemployment rates. As a result, simulations using these estimates suggest that national unemployment can be reduced with less inflationary pressures by targeting unemployment reductions at MSAs with high unemployment.

1. Introduction

Some economic theories hold that overall unemployment could be lowered, without increasing inflation, by lowering relative unemployment among high-unemployment groups, such as the less-educated. These theories assume that a group's unemployment affects wages much more when the group's unemployment is low than when the group's unemployment is high. Under this assumption, the inflationary pressures from a reduction in unemployment among high-unemployment groups can be offset by a smaller increase in unemployment among low-unemployment groups.

However, our empirical knowledge about how different groups' wages respond to unemployment is scant. Redistributing unemployment to reduce inflationary pressures may fail if 1) high-unemployment groups' wages are more responsive to unemployment than are low-unemployment groups, or 2) the wages of each group depend more on overall unemployment than the group's unemployment. This paper estimates how wages of different groups respond to group and overall unemployment. These estimates are used to simulate how lowering unemployment in various ways affects wage and price pressures.

This paper's estimates use wage, price, and unemployment data from 25 metropolitan areas (MSAs), 1979-98. Wage curves are estimated under three different ways of dividing up the MSA labor force, by race, education, and central city residence.

The estimates show that lowering unemployment among high-unemployment groups within an MSA does not reduce wage and price pressures. A group's wages depend more on overall MSA unemployment than on the group's unemployment. Unemployment has greater effects on low-unemployment groups than high-unemployment groups. However, lowering the relative unemployment of high-unemployment MSAs does significantly lower inflation.

2. Theory

This paper assumes that wages are determined by "wage curves," which relate wages to unemployment. Empirical evidence for wage curves is provided by Blanchflower and Oswald (1994).

A theoretical explanation of wage curves is offered by efficiency wage models. In such models, firms offer wages above the level that clears the market because higher wages increase profits. Higher wages may increase productivity by giving workers an incentive to avoid being fired for shirking (Shapiro and Stiglitz 1984). Higher wages may lower firms' turnover and hiring costs by lowering worker quit rates and making it easier to hire qualified new workers (Salop 1979; Weiss 1980). Higher wages may be perceived as fairer by workers, leading to greater worker effort (Akerlof 1982).

In efficiency wage models, higher unemployment may reduce the profit-maximizing wage. With higher unemployment, shirking is less of a problem. Higher unemployment will lower quit rates and make hiring easier. In a depressed economy, workers may see lower raises as fairer.

As pointed out by Layard, Nickell, and Jackman (1991), efficiency wage theories suggest that wages should be more sensitive to unemployment at low unemployment than at high unemployment.[1] For example, a reduction from two to one in the unemployment/vacancy ratio makes it much easier for workers to find jobs and much harder for firms to find workers, whereas

[1] This is based on the discussion in Layard, Nickell, and Jackman (1991), p. 201, who also cite Hall (1977) for a formal statistical analysis.

a reduction from six to five in the unemployment/vacancy ratio would have little effects on the odds of either workers or firms finding suitable job matches. At low unemployment, even a small change in unemployment will have relatively larger effects on the profit-maximizing wage.

The nonlinearity of the wage curve suggests that lowering relative unemployment among high-unemployment groups might allow lower overall unemployment with no increased inflation. Suppose the wages of each group are largely determined by the group's own unemployment. In that case, one might expect the effects of unemployment on the high-unemployment group's wages to be lower simply because of its higher unemployment rate. Then the wage inflation effects of a reduction in unemployment among high-unemployment groups could be offset by a smaller increase in unemployment among low-unemployment groups.

Theoretical models of improving the unemployment/inflation tradeoff by lowering relative unemployment of high-unemployment groups were developed some years ago by Baily and Tobin (1977, 1978).[2] Such models provided the intellectual underpinning for policy recommendations made in the late 1970s, but never enacted, to lower the "non-accelerating inflation rate of unemployment" (NAIRU) by public service jobs or subsidized private jobs for the disadvantaged (Palmer 1978; Haveman and Palmer 1982). Such policy approaches were rejected with the advent of the Reagan administration. Recently, policy interest in creating jobs for the poor has increased, in part as a response to the need of welfare recipients to find jobs given the 1996 welfare reform

[2]Baily and Tobin also suggested that lowering relative unemployment among low-wage groups might improve the unemployment inflation tradeoff because wages of different unemployment group indicate their "effective labor supply," which might determine wage and price pressures. The implicit model is that what really matters for inflation is capacity utilization, not the labor market. As discussed later in this paper, I tested this theory and find little support for it.

bill (see Ellwood and Welty [2000] for a review). It remains a relevant issue whether such job creation efforts improve the unemployment/inflation tradeoff.

However, there are some reasons to be skeptical about claims that the NAIRU can be lowered by lowering the poor's unemployment. First, as pointed out by Arthur Okun (1973), wages of low-skill groups may be more responsive to unemployment than are the wages of high-skill groups.[3] More skilled workers might be more important for firms to retain. As a result, firms may be more likely to enter into long-term wage arrangements with more skilled workers, which insulates the wages of these workers from cyclical changes in unemployment. Because firms have less invested in less-skilled workers, they are more willing to let their wages be determined by unemployment.

Second, what is the relevant "group" unemployment rate for determining wages? If mobility is "extensive enough" across a particular grouping of the labor force, then overall unemployment will drive a group's wages more than the group's own unemployment. In this case, redistributing unemployment among groups will not much change inflationary pressures.

This paper empirically tests some of these ideas by estimating wage curves for different groups. Previous research has failed to estimate how group wages respond to both group and overall unemployment, and the implications this has for efforts to improve the unemployment/inflation tradeoff.[4]

[3] Okun later used these arguments to criticize the original Tobin and Baily (1977) paper; see Okun's comments on p. 577 of the discussion of the Tobin-Baily paper.

[4] Baily and Tobin (1977) and Nichols (1982) estimate, using national time-series data, how the unemployment of groups affects overall wages. But they do not estimate effects on the unemployment of different groups.

3. Model and Data

The model is estimated in six different versions, which differ in how the labor force is grouped and in whether feedback from national variables is allowed. Each version of the model has three equations, one to explain MSA prices and the other two to explain MSA nominal wages for the two groups comprising the labor market. Local prices and wages are explained by lagged prices and wages, by local overall unemployment and local unemployment of each group, and, in some cases, by lagged national prices and wages. The model is estimated using pooled time-series cross-section data, in which each observation is an MSA average for a particular year. Twenty-five MSAs are included, as are all years from 1979 to 1998. The models divide the labor market into two groups in three different ways: white non-Hispanic vs. other races; college graduates vs. non-graduates; central city vs. suburban residents. Each of these three groupings is estimated in two ways: 1) treating national effects as fixed effects, and 2) treating national effects as random effects and including a lagged national wage or price variable in each equation if it is statistically significant. All equations include MSA fixed effects. Simulations examine effects of changes in group unemployment rates. Models with fixed effects implicitly assume that unemployment only changes in this MSA. Models with national wage or price variables can be simulated under some assumptions about how unemployment changes throughout the nation. A typical set of three estimating equations in the model can be written as:

$$\text{(1)} \qquad \ln P_{mt} = A_0 + A_1(\mathrm{L})\ln P_{mt\text{-}1} + A_2\ln W_{mt} + A_3 f_p(U_{mt}) + \mathrm{A}_m + A_\mathrm{t}\ [+\mathrm{A}_4\ln P_{t\text{-}1}] + e_{pmt}$$

$$\text{(2)} \qquad \ln W_{gmt} = B_{0g} + B_{1g}(\mathrm{L})\ln P_{mt\text{-}1} + B_{2g}(\mathrm{L})\ln W_{gmt\text{-}1} + B_{3g}(\mathrm{L})\ln W_{mt\text{-}1} + B_{4g} f_g(U_{gmt}) + B_{5g} f_g(U_{mt}) + B_{gm} + B_{gt}\ [+ B_{6g}\ln W_{gt\text{-}1}] + e_{gmt}$$

The second equation stands for the two groups' wage equations, with the dependent variable being nominal wages in MSA *m* and year *t* for group *g*, with each group having its own coefficients. The first equation explains prices in MSA *m* and year *t*. Coefficients followed by an (L) indicate that lags of the variable to the right are included. Several lags in local prices are included in all three equations. Current wages are included in the price equation, and lags in both group and overall wages are included in the group wage equations. For the price equation, some functional form for overall MSA unemployment in the MSA is included, and in the group wage equations, some functional form in both group and overall unemployment is included. All equations include MSA fixed effects (A_m or B_{gm}). All equations include either fixed national year effects, or random national year effects, represented in either case by A_t or B_{gt}. If year effects are random, the price model also includes lagged national prices, and the group wage equation for college graduates also includes lagged national wages for that group. (These terms are bracketed above to indicate that they only appear in some versions of the model.) National variables were only significant for these equations but not for the other five group wage equations (see below for details). The disturbance terms, represented by *e*, are assumed independent and identically distributed.

Functional forms and lag lengths are chosen through experimentation. Table 1 summarizes the final specifications. For unemployment in the price equation, I considered the following functional forms: the unemployment rate (UR); ln(UR); 1/(UR); $1/(UR)^2$; $(UR)^2$. For each functional form of unemployment, I considered just entering the current value, just entering the value lagged one year, or entering the current and lagged values together. The chosen specification was the lag of (1/UR), which minimized the Akaike Information Criterion, a standard model selection criterion.[5]

For each of the six group wage equations, I considered the same alternative specifications as in the price equation for unemployment, except that each wage equation included both overall unemployment and that group's unemployment. Although the specification varied across the six groups, in each equation I assumed that overall and group unemployment followed the same functional form and lag. The chosen specifications minimized the AIC. As shown in Table 1, for disadvantaged groups, the chosen specifications imply that unemployment has greater effects on wages at low unemployment than high unemployment, whereas for advantaged groups, unemployment has similar or smaller effects at low unemployment than high unemployment.

Preliminary tests for the price equation and the two wage equations for racial groups considered the employment-to-population ratio as an alternative to the unemployment rate. The best-fitting functional form from these employment-to-population ratio specifications was always clearly inferior to the best fitting functional form from the unemployment rate specifications.[6] Blanchflower and Oswald (1994) also found that local unemployment bested local-employment-to

[5] I also tested whether group unemployment rates help explain prices. The tests Baily and Tobin's hypothesis that a group's unemployment has less effects on prices if the group's wage right is low. The group unemployment rate was added in the same functional form and lag as overall unemployment. Unemployment of either non-college graduates or central city residents is statistically insignificant in the price equation. "Other race" unemployment variable is statistically significant. But lower "other race" unemployment, holding overall unemployment constant, is estimated to increase prices, which contradicts Baily and Tobin's hypothesis. For consistency purposes, I chose to only include overall unemployment in the price equation in all six versions of the model. It is hard to explain why lower relative unemployment of a low-wage group would have greater price effects. Allowing for the effects of "other race" unemployment on prices would only strengthen this paper's finding that targeting unemployment reductions at high-unemployment groups does not reduce inflation.

[6] These tests were done at a much earlier stage of the research, before 1997 and 1998 CPS data were available. The employment to population ratio was calculated for persons between 16 and 64 years old. At this early stage, I considered the same functional forms for both employment to population ratios and unemployment, but only the following lag specifications: current variables only; lagged variables only; and the average of current and lagged variables.

population ratios as a predictor of local wages. These results suggest that “unemployment,” as compared to being “out of the labor force,” is a meaningful labor market distinction in determining wage trends.

Other aspects of the specification also were subject to experimentation. I considered entering from one to eight lags in the local price variable in each of the three equations. I ended up choosing to enter five annual lags in the local price variable in all equations. This minimized the Akaike Information Criterion for the price equation and generally exceeded the AIC minimizing lag length for all of the wage equations.[7] Including five years of past prices is consistent with the theoretical notion that price expectations may depend in a complicated way on recent price trends and with empirical work using national data which finds that relatively long lags in price data help explain inflation (e.g., Gordon 1998).

For wage equations, I considered fewer lags, for two reasons: 1) because I have more years of price data than wage data, including one more lag in wages requires sacrificing 25 observations, one for each MSA; and 2) evidence from national data suggests that fewer lags in wages are needed to predict prices and wages (Gordon 1998, 1988). For the price equation, I considered adding an additional lag in overall local wages, but it was clearly insignificant. For the wage equations, I considered having from one to three lags in both group and overall wages. The second lag in wages was statistically significant in some wage equations, but the third lag was

[7] One exception was that seven lags in prices minimized the AIC for the suburban wage group. The AIC minimizing lag lengths for the other groups were white, 4; other race, 3; non-college graduate, 4; college graduate, 1; central city, 5.

never statistically significant.[8] Therefore, I included two lags in wages in all group wage equations.

After I settled on the specifications with year fixed effects, I considered random effects specifications with various national variables. Entering more than one national variable at a time led to extremely imprecise results. This probably occurs because there are only 18 years of national data (once a few years are dropped because of lags) with which to estimate the effects of national variables. Therefore, I decided to only include a maximum of one national variable in each equation. Entering lagged national prices in the price equation and each group's lagged national wage in the group wage equation is appealing because inter-MSA trade and migration would force local prices or wages to respond to changes in the same variable at a national level. Some tests showed that no other national variables had significantly better explanatory power than choosing one lag in the analogous national variable.[9]

National group wages were only statistically significant in the college graduate wage equation. For the other five labor market groups (non-college graduates, the two racial groups, the central city and suburban groups), national group wages were statistically insignificant, as were other national variables.[10]

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[8] Specifically, the *F*-test probabilities for the second lag in wages were white, 0.0548; other race, 0.4372; less than college, 0.0215; college or more, 0.0042; central city, 0.8202; non-central city, 0.1869. The third lag in wages never had an *F*-test with a probability less than 0.16.

[9] For example, the national price lagged one period had a *t*-statistic of 3.11 in the price equation. For this equation, I also looked at lagged national wages and the lagged national unemployment rate. The "best" national variable was the national wage lagged one year, which had a *t*-statistic of 3.12. In the wage equation for college graduates, the *t*-statistic on the national wage of that group is 2.82. In this equation, I also tried several specifications that each entered a different national variable, including lagged national overall wages, lagged national prices, and lagged national overall unemployment rate. The "best" *t*-statistic was for overall national wages, the coefficient on which had a *t*-statistic of 2.83.

[10] For these various labor market groups, the relevant *t*-statistics for the coefficient for the lagged national wage of that same group were 1.51 for the white non-Hispanic group; 1.40 for the other race group; 1.36 for non-college graduates; 1.42 for central city residents; and 1.21 for suburban residents. I also tried the following other

These findings suggest that labor markets for most groups are in some sense fundamentally local, in that local wages respond mainly to local trends in wages, unemployment, and prices. National trends do have important indirect effects on these groups' local wages by influencing local prices and local unemployment. In contrast, local wages of college grads are significantly affected by national wage trends. This may reflect the greater migration across MSAs of the college educated compared to other labor market groups. For example, for individuals with a college degree or more ages 25-64, 5.4% move into a typical MSA each year, whereas for individuals with a high school degree or less ages 25-64, only 3.9 percent move into a typical MSA each year (Series P20 figures for the 1996-97 period from the March 1997 CPS, U.S. Census 1997, Tables 25 and 28). In addition, local prices are significantly influenced by national price trends, which may reflect interregional trade.

Wage and unemployment data come from the Current Population Survey, Outgoing Rotation Group (CPS-ORG). Both wage and unemployment data are calculated after excluding observations that use imputations rather than actual survey responses. Wages are defined as usual weekly earnings divided by usual weekly hours. The wage data also screen out "outlier" wage observations, which are defined as observations in which the real hourly wage (in 1979 dollars) is less than $1 per hour, or more than $100 per hour, or in which the real wage is more than $40 per hour and usual weekly hours are less than 10 hours. The wage mean for each MSA and year for each group is a "regression-adjusted" mean. For each year, a preliminary regression was done of wages on a set of predictors, including MSA and regional dummies, a fourth-order polynomial in

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national variables: national overall wages lagged one year; national prices lagged one year; and the overall national unemployment rate lagged one year. For these five labor market groups, the largest *t*-statistic on a national variable was in the suburban resident wage equation, for which there was a *t*-statistic of 1.66 on national unemployment lagged one year.

age, a set of six dummies for different education levels, discrete variables for whether the individual was Black and whether the individual was Hispanic, a set of discrete variables for whether the person was female or married, the interaction between female and married, and a quadratic in the month of the observation. I then calculated for each group wage (as well as overall), what the wage would be in that MSA and year, for an individual with characteristics equal to the overall 1996 means for most of the variables, and the 1996 group means for other variables. Group means were used in regression adjustment for variables that had to vary across groups. For example, the mean of the discrete variables for Black and Hispanic must vary between the "White non-Hispanic" group, and the "other race" group, so separate means were used for these variables for those two groups. For unemployment, the weighted means of unemployment were used without adjustment.[11]

Price data were derived from the official CPI reported by BLS for each MSA. These indices measure prices for each MSA relative to a base year for the MSA, not according to some national standard. Although this is of no consequence because all estimation includes MSA fixed effects, I did make some attempt to adjust all prices so they were expressed relative to national prices in 1979.[12] This was done using BLS's indices of comparative costs of a total consumption basket for a lower living standard budget for a four-person family in 1979 (U.S. Department of Labor 1980, Table 153). The lower living standard budget was used because it uses data on

[11] I did some experimentation in using regression adjusted unemployment rates, and there appeared to be no difference in the results, so I used the simpler unadjusted unemployment rates. On the other hand, experimentation indicated that regression-adjusted wages explain local prices somewhat better than do unadjusted wages.

[12] The only real consequence of this adjustment is that it makes some slight difference in whether a few observations are excluded as wage outliers, because the wage outlier analysis was done after all wages were first adjusted to real wages using 1979 national prices.

comparative rents rather than home ownership costs, and, as is well-known, price indices for home ownership suffer from problems because of the investment aspects of the home ownership decision. In addition, the local prices indices in some of the earlier years were adjusted to a "rental equivalence" basis using national level data comparing the CPIU-X1 price index to the regular CPI-U index. This amounts to a fixed percentage adjustment in the inflation rate for all MSAs in a particular year and is of no consequence in regressions that include a fixed national year effect, and is probably not of much consequence when national effects are treated as random.

The 25 MSAs used are all those for which BLS consistently reports local price indices and for which the CPS definitions are reasonably consistent over time. To make MSA definitions more consistent over time, some MSAs were combined in some years for the CPS analysis. For example, San Francisco and Oakland were combined in recent years because these MSAs were combined in earlier years in the CPS. Despite these efforts, in some cases the MSA definitions in the CPS do shift a bit, adding or subtracting a county from the MSA definition. These counties added or subtracted are generally a small part of the MSA. If the counties included in the MSA are truly one labor market, we would not expect these additions or subtractions to have dramatic effects on regression-adjusted means of wage variables. Any measurement error that results is presumably part of the noise in the regression. In addition, for 1998, Buffalo has been dropped from the local CPI data, and Washington and Baltimore have been combined in the local CPI data. I imputed the price index for Washington and Baltimore by assuming a uniform inflation in each MSA's price index equal to the increase in the overall Washington/Baltimore price index from 1997 to 1998. For Buffalo, I assumed that its 1997-98 inflation was equal to the inflation rate for MSAs of its size in the Northeast. These imputations presumably add some noise to the 1998 dependent variable for the price equation (1998 values of prices do not enter the wage equations). Reestimating the price equation with these two observations dropped did not change any results.

Table 2 lists means and standard deviations of unemployment and wages as well as overall unemployment for each MSA as of 1998, the lowest unemployment year in the sample. These data show the expected pattern of higher unemployment and lower wages for disadvantaged groups. The data also emphasize that the variation in unemployment among MSAs and years is large. Furthermore, recent unemployment in some MSAs has been quite low. This suggests that these data may reveal how much inflation is caused by unemployment that is lower than the 1998 national unemployment rate of 4.5%. One problems in studies using national data is that it is difficult to determine the inflation effects of unemployment as low as current levels, because we have rarely experienced such low unemployment in recent years at the national level. This is not true at the local level.

For some simulations, we want to know how group unemployment typically varies as overall unemployment is reduced. Several methods might predict this. Regressing one group's unemployment rate on the other's is unsatisfactory, because such an equation implicitly assumes that the shock to overall unemployment originates in one group. Regressing group unemployment on overall unemployment is problematic because of differences in the labor share of different groups in different MSAs and years. Instead, I assume that there is a fixed correlation between the unemployment rates of different groups. With estimated covariances and variances of group unemployment rates, one can derive an equation to predict each group's unemployment given overall unemployment.[13]

[13] The note to Table 3 provides the relevant formulas.

Table 3 reports what these estimated relationships imply for how group unemployment rates vary as overall unemployment varies from 10% to 2%. These estimates are consistent with the conventional wisdom that unemployment of the disadvantaged declines disproportionately as overall unemployment is reduced. It is noteworthy that "other race" unemployment converges on White unemployment as unemployment is reduced to 2%, and that central city unemployment converges on non-central city unemployment as unemployment is reduced to 2%. In contrast, the gap between unemployment rates of college graduates and non-graduates persists at low unemployment rates. This suggests that labor market distinctions between groups by education level are in this respect more fundamental than distinctions by ethnic group or residential location.

4. Results

I first consider models with fixed effects for each year. Such models fully control for national trends. However, fixed effects models can only examine the effects of changes in local unemployment, as national unemployment is implicitly held constant by the fixed year effects. To allow for changes in national variables, I also estimate models in which national year effects are treated as random (MSA effects continue to be treated as fixed). With random national effects, the models can estimate the effects of changes in national variables on local wages and prices. This allows simulation of effects of changes in unemployment throughout the nation.

<u>Fixed effect models</u>

Table 4 reports coefficient estimates from fixed effects models. The most noteworthy finding is that the group unemployment rates' effects on group wages, holding overall unemployment constant, is always statistically insignificant at the conventional 5% level of significance. On the other hand, each group's wages are considerably affected by overall labor market conditions. In five of the six wage equations, lagged overall wages have significant effects on the current wages of each group, holding lagged wages of the group constant. In four of the six wage equations, overall unemployment has significant effects on group wages, holding the group's unemployment constant. (In the other equations, the estimation is not precise enough to tell whether either group or overall unemployment, considered separately, have statistically significant effects on group wages).

These results suggest that there is enough mobility across groups that different groups' wages respond more to overall MSA labor market conditions than to the unemployment rates of the group. It is noteworthy that group unemployment rates come closest to statistical significance for the wage equations for central city residents and suburban residents. Apparently geographic barriers (information? transportation?) create labor submarkets that respond to their own submarket unemployment trends, but differences in worker education or race by themselves are insufficient to prevent groups from responding to overall labor market trends.

To show the dynamic response of wages and prices to lower MSA unemployment, Figure 1 uses the estimated fixed effect models to simulate the effects of lowering overall MSA unemployment from 6% to 4%. National unemployment is implicitly held constant. The relative unemployment of different groups at 6% and 4% unemployment are derived from Table 3, and therefore Figure 1 shows a "typical" pattern of group unemployment reductions when overall unemployment is reduced. The three parts of the figure show three models, each segmenting the labor force differently.

As the figure shows, unemployment reductions cause prices and real wages to increase, settling down at a new higher level after about 10 years. In all three models, a normal reduction in overall unemployment – which includes a reduction in relative unemployment of the disadvantaged—increases the relative real wages of the disadvantaged, although this effect is slight in the race model. The overall increase in prices is similar in all three models, but the increase in real wages is somewhat less in the race model. The lower real wage increases in this model are due to lower real wage increases of the race model's disadvantaged group.

Table 5 reports simulations of how MSA prices and real wages respond to various patterns of lowering local unemployment among different groups. Table 5 shows effects after 10 years which, as shown in Figure 1, reveal long-run effects. For normal reductions in overall unemployment by 1% (the right-most column), local prices go up by 1.2% to 1.4%. Overall real wages go up by 0.9% to 1.6%, implying that nominal wages go up by 2 or 3%.

These 2-3% effects on nominal wages after 10 years seem roughly compatible with the wide range of previous estimates. Blanchflower and Oswald's (1994) estimates imply that a reduction from 6% to 5% unemployment will increase nominal annual earnings by 1.8%.[14] Their focus on nominal earnings will overstate the effects of unemployment on nominal wages. However, their model constrains the short-run and long-run effects on earnings to be the same, which should understate the long-run effects of unemployment on wages. Card's (1995) estimates imply that a reduction from 6% to 5% unemployment will increase nominal hourly wages by 1.5%.[15] His specification, like Blanchflower and Oswald's, constrains short-run and long-run

[14]Blanchflower and Oswald's preferred estimate is that the elasticity of pay with respect to unemployment is about -0.1. Most of their estimates use annual earnings rather than hourly wages. At initial unemployment of 6%, a reduction to 5% would increase the log of nominal earnings by 0.018.

[15]This is derived from Card's Table 3, column 2.

effects of unemployment on wages to be the same, which should cause this specification to understate the long-run effects. Blanchard and Katz's (1997) estimates imply that a reduction in local unemployment from 6% to 5% will increase local nominal wages after 10 years by 5.4%.[16] Their specification only allows for dynamics by including one lag in wages. This dynamic specification may overstate long-run effects on wages if wages adjust rapidly at first but then much more slowly over time, as they seem to do in Figure 1.

When examining marginal reductions in unemployment of different groups, it is quickly apparent that changing the distribution of unemployment does not much change price or real wage effects. Generally both groups' wage rates go up when either group's unemployment rate goes down (an exception being that declines in college unemployment rates seem to have nil real wage effects). Although relative wages of a group increase when its relative unemployment goes down, these relative wage effects are modest. Wage trends for these groups are closely interconnected.

As a result, as shown in Table 5, it makes little difference to prices and real wages whether we lower group unemployment rates in the normal manner—which tends to lower the relative unemployment of the disadvantaged—or instead lower both groups' unemployment rates by the same amount. In fact, lowering both groups' unemployment by the same amount, which focuses more of the unemployment reduction on advantaged groups, reduces slightly the price and real wage effects of lower unemployment.

To dramatize the smallness of the price effects of different distributions of unemployment, Figure 2 considers two different patterns of lowering unemployment that differ drastically in how

[16] I derive this from column (3) of Table 2 in Blanchard and Katz (1997, p. 64). They report an effect of log unemployment on log nominal wages of -0.041, and an effect of lagged wages on current wages of 0.911.

much unemployment of different groups is lowered. Pattern 1 was shown in Figure 1: both groups' unemployment rates are lowered as they normally would be when unemployment is lowered from 6% to 4%. In the other pattern, both groups' unemployment rates are equalized at 4%, which requires substantial changes in relative unemployment.

Figure 2 shows that focusing more of the unemployment reduction on the disadvantaged does not reduce price pressures, as Baily and Tobin conjectured. In fact, if anything, prices go up slightly more when unemployment reductions are targeted on the disadvantaged. These slightly greater price pressures may occur because the wages of the disadvantaged are more responsive to unemployment than are the wages of the advantaged, and these greater wage increases put upward pressure on prices.

Figure 2 also shows that targeting unemployment reductions on the disadvantaged increases the relative real wages of the disadvantaged. This reinforces the progressive distributional effects of lower relative unemployment of the disadvantaged. Although targeting unemployment reductions on the disadvantaged is not an anti-inflation tool, one can still support such a policy on distributional grounds and argue that its extra price inflation effects are modest.

A fuller picture of the effects of unemployment on local wage and prices requires looking at the effects of a wider range of unemployment rates. Figure 3 plots the price and real wage effects of changing from an overall unemployment rate of 6% to several overall unemployment rates, ranging from 2% to 10%. Unemployment of different groups changes in the "typical" fashion; the effects shown are effects after 10 years, or "long-run effects." The resulting plots can be described as "price curves" or "real wage curves" that show the long-run response of price and real wage levels to unemployment. The plots can also be described as Phillips curves, as they show the 10-year change in prices and real wages.

The price curves are similar in all three models. These price curves are clearly convex. An unemployment reduction from 4% to 2% local unemployment causes a greater effect on prices than a reduction from 10% to 4%. Real wage curves for the disadvantaged are also convex. These convexities reflect the functional forms chosen to best fit the relationship between unemployment, and prices and real wages of the disadvantaged. On the other hand, wage curves for the advantaged are linear or slightly concave, again reflecting the functional forms chosen to best fit how unemployment affects the advantaged's wages. Particularly at low unemployment rates, real wage curves for the disadvantaged are much steeper (more negatively sloped) than are real wage curves for advantaged groups. This tendency is more pronounced in the education and city/suburb models than in the race model. In the education model, real wages of the less-educated are much more responsive to changes in local unemployment than are the more-educated at most observed unemployment rates. The real wage rates of the college educated are relatively insensitive to local unemployment. As mentioned above and again below, this may be explained by the greater migration of the college educated, which links their real wage more to national trends.

Random effect models

I now presenting simulations derived from estimated random effects models. Because these random effects models allow for the influence of national variables on local variables, simulations using random effects models can examine what happens if unemployment changes both in the local labor market and in the nation as a whole.

For the same variables, the random effects and fixed effects models yield similar coefficient estimates. (The raw coefficient estimates for the random effects models are reported in appendix Table A1.) Hausman tests for whether the random year effects are orthogonal to the regressors always decisively accept the null hypothesis of orthogonality.[17]

The two equations with statistically significant national effects are the equation predicting local prices and the equation predicting local wages of college graduates. In the equation predicting local ln(price level), lagged ln(national price level) has a coefficient of 0.121 (t-statistic = 3.11). In the equation predicting local ln(wage of college graduates), the coefficient on lagged ln(national wages of college graduates) is 0.282 (t-statistic = 2.82). As mentioned above, the significant influence of national prices on local prices may arise from interregional trade. The significant effects of national wages of college graduates on local wages may reflect the interregional migration of college graduates.

Many types of simulations can be done with the random effects model. National variables are set equal to the average of variables in local labor markets comprising the model. Simulations can differ in the detail with which they model the many U.S. local labor markets and in what pattern of local unemployment reductions is examined. The simplest and least interesting simulation is to analyze an unemployment reduction in one MSA, with no unemployment reductions elsewhere. If the MSA is small, there will be no significant change in national variables (which is to say the national variables are held constant). Such a simulation should yield similar estimates to the fixed effects model. Simulations not presented here show this to be the case.

[17]The Hausman tests (see Greene 1993, pp. 479-480) test for significant differences between the fixed effects and random effects estimates. Under the null hypothesis of orthogonality, both estimates are consistent but the random effects estimates are more efficient, and the two sets of estimates should not differ significantly.

A simple simulation approach that includes national effects in a meaningful way is to assume that the United States is comprised of a number of identical MSAs, all of which experience an identical unemployment reduction. In this case, the change in national variables will be equal to the change in local variables, and these national variables will influence the change in local variables next year. This simulation approach may be a reasonable summary of the typical effects of lowering unemployment throughout the United States. In the real world, with diverse initial unemployment rates, national wages and prices will be pushed up more by unemployment reductions in low unemployment areas, where the greater upward wage and price pressures will more than offset the lower upward wage and price pressures from reducing unemployment in high-unemployment areas. On the other hand, typical national unemployment reductions probably will lower relative unemployment in high-unemployment areas, which will reduce the wage and price effects of lower national unemployment. These offsetting biases leave it uncertain whether a real world national unemployment reduction will have more or less inflationary effects than a uniform unemployment reduction in an imaginary world with identical MSAs.

Under the simplifying assumptions of identical MSAs and uniform reductions in unemployment in all MSAs, Figure 4 uses the random effects estimates to simulate the effects of reducing national unemployment from 6% to 4% on prices and real wages in the nation as a whole. There are several notable features of these simulation results. First, the effects on prices of reducing unemployment everywhere are much greater than the effects on prices of reducing unemployment in only one MSA (see Figure 1). For example, prices after 10 years go up almost twice as much when unemployment is reduced everywhere than when prices are reduced in just one MSA. These greater effects are largely due to the feedback effects from including lagged national prices in the equation explaining local prices.

Second, these estimated effects of lower unemployment on prices are significantly lower in the long run than one would get in models using national data that impose the assumption of a non-accelerating inflation rate of unemployment (a NAIRU), but the effects are similar to price effects in models using national data that estimate a more flexible functional form. For example, Fair (1999) reports 10-year effects of lower national unemployment on prices that are quite similar to those estimated here, but finds much greater effects when he imposes restrictions (which are statistically rejected) that assume a NAIRU.[18]

Third, lowering unemployment everywhere yields much more persistent effects on inflation than lowering unemployment in just one MSA. As can be seen in the figure, the point estimates suggest that lower unemployment causes inflation that persists throughout the 20-year period considered, with inflation only slowly tapering off towards the end of the period. In addition, the standard errors on these estimated effects increase as the length of the simulation increases, so that it is impossible to reject the hypothesis that inflation is accelerating in response to lower unemployment. For example, in the education model, the increase in ln(national price) after 10 years is 0.069, and after 20 years is 0.123, but the standard error on the 20-year increase in prices is 0.044, so the true 20-year increase in prices could be greater than twice the 10-year effect.

[18] Fair (1999) estimates a 10-year effect that 1 percent lower unemployment raises ln(price) by 0.031 in his most flexibly estimated model. This is about half the effects of 2% lower unemployment that are reported in Figure 4; directly estimating the effects of lowering unemployment from 6% to 5% in the education model used in this paper yield an estimated effect on ln(price) of 0.030 (t-statistic of 5.20). A model that imposes the NAIRU assumptions, which Fair rejects, estimate a 10 year effect of one point lower unemployment on ln(price) of 0.202.

Fourth, with the exception of wages for college graduates, the effects of lower unemployment on the level of real wages, and how those effects change over time, are quite similar with unemployment decreasing everywhere (Figure 4) and just in one MSA (Figure 1). Even though prices are steadily increasing in the Figure 4 model, real wages for most groups reach a new equilibrium level after about 10 years. Real wages for most groups increase by about 1.5% to 4.5% in the long run, similar to the increases reported in the Figure 1 model. In the race model and the city/suburb model, lower unemployment increases the relative wage of the more disadvantaged group, although the effects are slight in the race model.

Fifth, in the Figure 4 model, the real wages of college graduates increase more and continue increasing for a longer period than they do in the fixed effects model of Figure 1. These much greater effects on college graduate wages are attributable to the feedback incorporated into the model from national wages of college graduates to local wages. These effects on college graduate wages are large enough that after eight years or so, lower unemployment is estimated to have slightly greater effects on college graduate wages relative to non-graduate wages. However, as indicated in the table below Figure 4, these estimated effects on college graduates are only imprecisely estimated. It should be noted that even if lower unemployment did not have progressive effects on the wages of non-graduates vs. college graduates, it still would increase the relative employment and earnings of non-graduates vs. college graduates, because lower overall unemployment drives down the relative unemployment rate of non-graduates vs. graduates.

As was done with the fixed effect model in Figure 3, the random effects model with identical MSAs and identical unemployment everywhere can be used to generate “price curves/wage curves.” The curves resulting from these simulations are presented in this paper’s appendix. The resulting price and real wage curves look quite similar to those of Figure 3, except that the absolute magnitude of all the price effects at different unemployment rates are higher, and real wages of college graduates are more responsive to unemployment. However, price curves and real wages curves for the disadvantaged are still convex, with considerably greater responsiveness to unemployment at low levels of unemployment.

In addition, as was done with fixed effects models in Figure 2, the random effects model with identical MSAs can be used to analyze whether inflationary pressures can be reduced by targeting unemployment reductions more on disadvantaged groups. The results from this exercise are also reported in an appendix. These results are very similar to what were obtained in Figure 2. In general, targeting unemployment reductions more on high unemployment groups results in slightly greater effects of a given overall unemployment reduction on the price level.

Random effects models with national influences on local variables do allow us to address a new issue: would targeting unemployment reductions on high-unemployment local labor markets help reduce inflationary pressures? To address this issue, I consider a hyopthetical national economy that is initially evenly divided into two types of MSAs: MSAs with 8% overall unemployment; MSAs with 4% unemployment. Average national overall unemployment is thus initially 6%. Simulations consider the effects of two different methods of lowering overall national unemployment to 4%. Method 1 lowers every MSA’s unemployment rate by 2%, so that half the MSAs now have 6% unemployment, and the other half have 2% unemployment. Method 2 equalizes unemployment in all MSAs at 4%.

The results from these simulations are similar in all three models, so I present in the main text the results from the city/suburb model and present results from the other two models in the appendix. As shown in Figure 5, targeting the unemployment reduction on the initially high-unemployment MSAs greatly reduces inflationary pressures. For example, 10 years after the unemployment reduction, the average ln(national prices) has increased by 0.098 when unemployment is reduced evenly in all MSAs, but by only 0.050 when the unemployment reduction is targeted at the high-unemployment areas. These differences largely reflect the non-linear effects of local unemployment rates upon local prices, with local prices increasing far more for a reduction from 4% to 2% than for a reduction from 6% to 4%. As shown in the bottom part of the figure, targeting the unemployment reduction on high unemployment MSAs, compared to lowering unemployment evenly everywhere, avoids a large boost to prices that occurs if one lowers unemployment in already-low unemployment MSAs, at a more modest cost in increased prices from a greater reduction in unemployment in high-unemployment MSAs. With feedback between national prices and local prices, over time a targeting strategy even moderates somewhat the price effects of lower unemployment in the targeted MSAs.

5. Conclusion

This paper presents empirical estimates that suggest that different groups within a local labor market experience similar wage trends in response to changing unemployment. On the other hand, local labor markets can show somewhat different wage trends from the nation. As a result, policies to restrain upward wage and price pressures can do more through redistributing unemployment among regions than across groups within the same labor market.

Does this mean that there is no scope for reducing upward wage and price pressures by targeting more demand pressures on particular groups within a local labor market? Such a conclusion extrapolates the results too far. The wage curve models estimated in the paper, and in Blanchflower and Oswald (1994), find that wages depend on unemployment, not employment-to-population ratios. An employment policy that targeted non-labor force participants might increase employment with less inflationary pressures than "normal" employment increases. However, targeting non-labor force participants for employment is probably a more difficult policy than simply encouraging the employment of the disadvantaged who are unemployed. Such employment policies must be more selective in choosing who is hired for public service jobs, or subsidized in private sector employment.

Table 1: Summary of Functional and Lag Length Specification of Price and Wage Curve Equations

Dependent variable	Local unemployment variable	Other local variables (in addition to MSA fixed effect)	National variable (in specifications without national fixed effect, and with national random effect)
ln(local price level)	lag (1/overall UR)[a] unemployment rate)	5 annual lags in ln(local prices); current value of ln(overall local nominal wages)	lagged ln(national price level)
ln(regression-adjusted local nominal wages for some group of workers)	Includes variables for both groups' unemployment rate and overall unemployment in MSA. Functional form and lag structure depends on group White: lag UR Other race: lag(1/UR) College grad: lag(UR)^2 Non-grad: current and lag log(UR) City: lag(1/UR) Suburb: current and lag(UR)	5 annual lags in ln(local prices); 2 annual lags in ln(overall local wages) and ln(group local wages)	lagged ln(national nominal wages for group) for the college grad equation; no national variables included in wage equations for other groups

[a] UR = unemployment rate

Table 2: Descriptive Statistics on Local Unemployment and Wage Data, 1979-98, 25 MSAs

Panel A: Means and Standard Deviations

	Proportion of labor force, average across 25 MSAs, 1979-98	Mean of MSA unemployment rates, all years and MSAs (St. Dev.)	Mean of MSA ln(adjusted real wage), in 1979 dollars (St. Dev.)
Overall	1.000	6.4 (2.2)	1.639 (.064)
White non-Hispanic	0.716	4.9 (1.9)	1.680 (.069)
Other races	0.284	11.7 (5.3)	1.557 (.080)
Non college graduate	0.723	7.6 (2.5)	1.555 (.067)
College graduate	0.277	2.8 (1.2)	1.943 (.080)
Central city	0.357	8.9 (3.8)	1.614 (.077)
Suburban	0.643	5.3 (2.0)	1.651 (.067)

Note: The means here are "means" of means, that is they are unweighted means and standard deviations across observations on MSA-year means for 25 MSAs and all years from 1979-98. The underlying data are calculated from the CPS Outgoing Rotation Group, as described in the text. The unadjusted means for unemployment for each MSA-year are calculated using CPS sampling weights. The regression-adjusted means for ln(wage rate) are based on preliminary regression of ln(real wage) on a variety of wage predictors.

Panel B: 1998 MSA means for overall unemployment rate

MSA	1998 unemployment rate	MSA	1998 unemployment rate
Atlanta	2.9%	Miami	7.0%
Baltimore	5.3	Milwaukee	3.4
Boston	2.6	Minneapolis/St. Paul	1.8
Buffalo	2.9	New York	6.2
Chicago	5.0	Philadelphia	5.2
Cincinnati	3.8	Pittsburgh	4.2
Cleveland	3.1	Portland (OR)	4.8
Dallas	3.8	St. Louis	5.0
Denver	3.1	San Diego	5.5
Detroit	4.2	San Francisco	3.9
Houston	4.2	Seattle	2.8
Kansas City	3.4	Washington D.C.	3.2
Los Angeles	6.8		

Note: The official national unemployment rate in 1998 was 4.5%. The simple mean across these 25 MSAs in 1998 was 4.2%.

Table 3: Estimated Relationships Between Group Unemployment Rates and Overall Unemployment Rates

Overall UR	White UR (implied slope coefficient with respect to overall UR=0.64)	Other race UR (slope = 1.92)	Non-college grad UR (slope = 1.24)	College grad UR (slope = 0.38)	Central city UR (slope = 1.47)	Suburban UR (slope = 0.74)
2%	2.1	1.8	2.3	1.1	2.1	2.0
3%	2.7	3.8	3.6	1.5	3.5	2.7
4%	3.3	5.7	4.8	1.9	5.0	3.4
5%	4.0	7.6	6.0	2.3	6.5	4.2
6%	4.6	9.5	7.3	2.7	7.9	4.9
7%	5.2	11.4	8.5	3.1	9.4	5.7
8%	5.9	13.4	9.7	3.5	10.9	6.4
9%	6.5	15.3	11.0	3.8	12.4	7.1
10%	7.1	17.2	12.2	4.2	13.8	7.9

Note: The numbers in the above table are calculated assuming that there is a constant correlation between the different group unemployment rates. Suppose that we are trying to predict how the unemployment of two groups that encompass the labor force, g and h, will vary with overall unemployment. This prediction is implicitly holding constant the labor force weights of the two groups, W_g and W_h. The prediction equation can be written as $U_g = B_{0g} + B_{1g}U$, where U, overall unemployment, is defined as $U = W_gU_g + W_hU_h$. Then $B_{1g} = \mathrm{Cov}(U_g,U)/\mathrm{V}(U)$. If U_g and U_h have fixed covariances and variances, then $\mathrm{Cov}(U_g,U) = W_g\mathrm{V}(U_g) + W_h\mathrm{Cov}(U_g, U_h)$, and $\mathrm{V}(U) = (W_g)^2\mathrm{V}(U_g) + (W_h)^2\mathrm{V}(U_h) + 2W_gW_h\mathrm{Cov}(U_g,U_h)$. Once we have determined B_{1g}, B_{0g} can be determined by substituting in mean values of the unemployment rates in the prediction equation, and solving for B_{0g}. A similar exercise gives us the prediction equation for U_h. The covariances and variances of each pair of group unemployment rates were calculated using the residuals from a regression of each pair of group unemployment rates on MSA and year dummies, using the complete sample of 25 MSAs from 1979-98. By doing these calculations using the residuals, I am implicitly calculating how group unemployment rates vary with overall unemployment, holding constant unobserved fixed MSA and year effects. The weights used for the labor force were the same ones reported in Table 2, and are based on the sum of the CPS labor force weights over all MSAs and years. The mean unemployment rates used to determine the intercept were weighted mean unemployment rates, using labor force weights, which are similar but not identical to the unweighted means reported in Table 2.

Table 4: Relevant Coefficient Estimates from Final Wage and Price Equation Models, Fixed National Year Effects

Observations are on MSA/year cell means for variables labor market variables. Each column corresponds to one of the seven equations estimated. Dependent variable for equation is listed at the top. Second row lists functional form for unemployment used on right-hand side of that equation. Subsequent rows list various right-hand side variables and give the estimated coefficients on these RHS variables in each equation, with *t*-statistics in parentheses. All equations also include dummies for each MSA and each year. Last row lists relevant *F*-test probabilities in each equation for variables of a particular type.

	Dependent variables in each of seven equations:						
	Mean ln(wage) of white non-Hispanics in that MSA and year	**Mean ln(wage) of other races in that MSA and year**	**Mean ln(wage) of persons with less than college education in that MSA and year**	**Mean ln(wage) of college graduates in that MSA and year**	**Mean ln(wage) of central city residents in that MSA and year**	**Mean ln(wage) of non-central city residents in that MSA and year**	**ln(average consumer prices) in that MSA and year**
Functional form of unemployment on RHS	UR	1/UR	ln(UR)	UR^2	1/UR	UR	1/UR
Coefficient On:							
Current UR, group			-0.0268 (-1.37)			0.330 (1.91)	
Lag UR group	0.089 (0.44)	0.00050 (0.57)	-0.0061 (-0.30)	2.467 (0.94)	0.00083 (1.55)	-0.182 (-1.03)	
Current local UR			0.0120 (0.58)			-0.435 (-2.43)	
Lag local UR	-0.503 (-2.80)	0.00128 (1.45)	-0.0213 (-0.99)	-3.472 (-4.19)	0.00170 (2.71)	-0.225 (-1.26)	0.00047 (3.81)
Lag ln(wage group)	0.363 (3.37)	0.220 (4.03)	0.243 (2.48)	0.189 (3.10)	0.330 (5.61)	0.420 (4.57)	
2nd lag ln(wage group)	-0.160 (-1.46)	-0.068 (-1.19)	0.247 (2.51)	-0.201 (-3.33)	-0.023 (-0.38)	0.073 (0.79)	
Current ln (overall wage)							0.0634 (4.17)
lag ln(overall wage)	0.216 (1.79)	0.440 (3.29)	0.426 (3.97)	0.303 (2.69)	0.346 (3.41)	0.213 (2.00)	

Table 4. (Continued)

	Dependent variables in each of seven equations:						
	Mean ln(wage) of white non-Hispanics in that MSA and year	**Mean ln(wage) of other races in that MSA and year**	**Mean ln(wage) of persons with less than college education in that MSA and year**	**Mean ln(wage) of college graduates in that MSA and year**	**Mean ln(wage) of central city residents in that MSA and year**	**Mean ln(wage) of non-central city residents in that MSA and year**	**ln(average consumer prices) in that MSA and year**
2nd lag ln(overall wage)	0.268	0.144	-0.136	0.232	0.068	0.026	
	(2.17)	(1.06)	(-1.25)	(2.09)	(0.65)	(0.24)	
Lag 1 ln(price)	0.318	0.086	0.333	0.032	0.095	0.278	0.976
	(2.81)	(0.33)	(2.95)	(0.17)	(0.53)	(2.29)	(21.66)
Lag 2 ln(price)	0.002	0.175	-0.080	0.330	0.094	0.039	-0.242
	(0.01)	(0.50)	(-0.52)	(1.30)	(0.39)	(0.24)	(-3.86)
Lag 3 ln(price)	0.036	-0.106	-0.063	-0.088	-0.021	-0.064	0.075
	(0.24)	(-0.31)	(-0.42)	(-0.36)	(-0.09)	(-0.40)	(1.18)
Lag 4 ln(price)	-0.078	-0.060	-0.008	0.133	0.288	-0.036	0.085
	(-0.53)	(-0.18)	(-0.06)	(0.55)	(1.27)	(-0.23)	(1.39)
Lag 5 ln(price)	-0.104	-0.166	-0.128	-0.268	-0.397	-0.095	-0.130
	(-1.08)	(-0.77)	(-1.35)	(-1.72)	(-2.69)	(-0.92)	(-3.27)
F-tests probability:							
All UR variables	0.0001	0.0534	0.0001	0.0001	0.0001	0.0001	0.0002
UR-group	0.6636	0.5662	0.3815	0.3466	0.1211	0.1336	
UR-overall	0.0054	0.1491	0.5300	0.0001	0.0070	0.0051	0.0002
Wage-group	0.0037	0.0003	0.0002	0.0002	0.0001	0.0001	
Wage-overall	0.0004	0.0001	0.0004	0.0001	0.0001	0.0571	0.0001

Note: UR variables are defined as proportions, that is, are generally between 0.01 and 0.12.

Table 5: Some Simulation Results From National Fixed Year Effect Models of the Effects of Changes in Unemployment

All effects are effects after 10 years, with unemployment reduction considered to take place in year 0. *t*-statistics are in parentheses. All simulations start with overall unemployment of 6%, with pattern across groups as given in Table 3.

Panel A: Other race/White non-Hispanic grouping (Lf shares: .284, .716; starting URs at 6%: 9.52, 4.60)

	1% decline in UR, disadvantaged group	1% decline in UR, advantaged group	1% decline in UR, both groups	1% decline in overall unemployment, predicted pattern for both groups(final URs of 7.60, 3.97)
ln(price)	0.00336	0.00800	0.01202	0.01239
	(4.57)	(4.39)	(4.82)	(4.97)
ln(overall real wage)	0.00294	0.00474	0.00759	0.00864
	(2.36)	(1.62)	(2.38)	(2.85)
ln(real wage, disadv. group)	0.00282	0.00384	0.00674	0.00819
	(1.74)	(0.94)	(1.32)	(1.67)
ln(real wage, adv. group)	0.00298	0.00508	0.00791	0.00882
	(2.36)	(1.74)	(2.68)	(3.20)

Panel B: Less than college/college graduate grouping (Lf shares: .723, .277; starting URs at 6%: 7.27, 2.68)

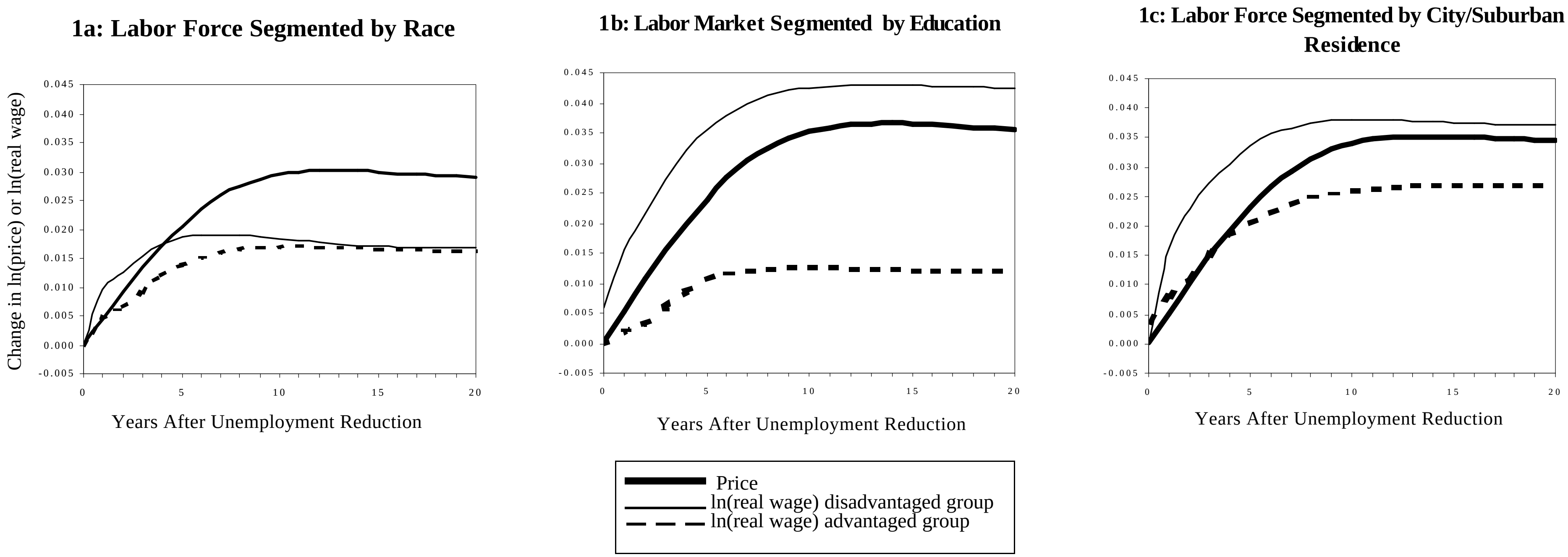
	1% decline in UR, disadvantaged group	1% decline in UR, advantaged group	1% decline in UR, both groups	1% decline in overall unemployment, predicted pattern for both groups (final Urs of 6.04, 2.30)
ln(price)	0.01097	0.00219	0.01374	0.01498
	(5.57)	(1.70)	(5.21)	(5.66)
ln(overall real wage)	0.01309	-0.00024	0.01256	0.01611
	(3.95)	(-0.07)	(3.00)	(4.08)
ln(real wage, disadv. group)	0.01587	-0.00004	0.01562	0.01977
	(4.04)	(-0.01)	(3.12)	(4.26)
ln(real wage, adv. group)	0.00618	-0.00073	0.00498	0.00703
	(2.52)	(-0.40)	(1.63)	(2.25)

Panel C: Central city/suburban grouping (Lf shares of .357, .643; starting URs at 6%: 7.95, 4.92)

	1% decline in UR, disadvantaged group	1% decline in UR, advantaged group	1% decline in UR, both groups	1% decline in overall unemployment, predicted pattern for both groups (final Urs of 6.47, 4.18)
ln(price)	0.00522	0.00780	0.01384	0.01438
	(5.17)	(4.62)	(5.47)	(5.64)
ln(overall real wage)	0.00646	0.00636	0.01288	0.01441
	(3.35)	(2.08)	(3.57)	(3.98)
ln(real wage, disadv. group)	0.00712	0.00662	0.01426	0.01623
	(3.76)	(2.09)	(3.33)	(3.83)
ln(real wage, adv. group)	0.00611	0.00622	0.01214	0.01343
	(2.72)	(1.77)	(3.04)	(3.34)

Notes: t-statistics are psuedo t-statistics derived from 1000 repetitions of simulation, with mean estimated effect divided by standard deviation of effect in 1000 repetitions.

Figure 1: Effects on Local Prices and Real Wages of Lowering Local Unemployment from 6% to Four%, with "Normal" Pattern of Lowering Unemployment Rates of Different Labor Market Groups



Effects on Local Prices and Real Wages After Ten Years of Lowering Unemployment from Six Percent to Four Percent, Each Group's Unemployment Declines "Normally" (*t*-statistics in parentheses)

Variable	Model grouping labor market by race	Model grouping labor market by education	Model grouping labor market by central city/suburban residence
ln(price)	0.02947	0.03528	0.03402
	(4.86)	(5.57)	(5.52)
ln(overall real wage)	0.01734	0.03396	0.03032
	(2.45)	(3.79)	(3.70)
ln(real wage disadvantaged group)	0.01837	0.04253	0.03810
	(1.53)	(4.05)	(3.73)
ln(real wage advantaged group)	0.01695	0.01271	0.02613
	(2.75)	(1.81)	(2.96)

Notes: Disadvantaged group/advantaged group are other race/White non-Hispanic for race grouping; less than college graduate/college graduate for education grouping; central city resident/suburban resident for geographic residence model. In a normal decline in MSA unemployment from 6% to 4%, each group's unemployment declines as described in Table 3. This implies disadvantaged group's unemployment declines more than advantaged group's unemployment declines.

Figure 2: Price and Wage Effects of Lowering Local Unemployment from 6% to 4%, in Three Different Models, Using Two Different Patterns of Lowering Unemployment: "Normal" Unemployment Reductions; Equalizing all Groups' Unemployment at 4%

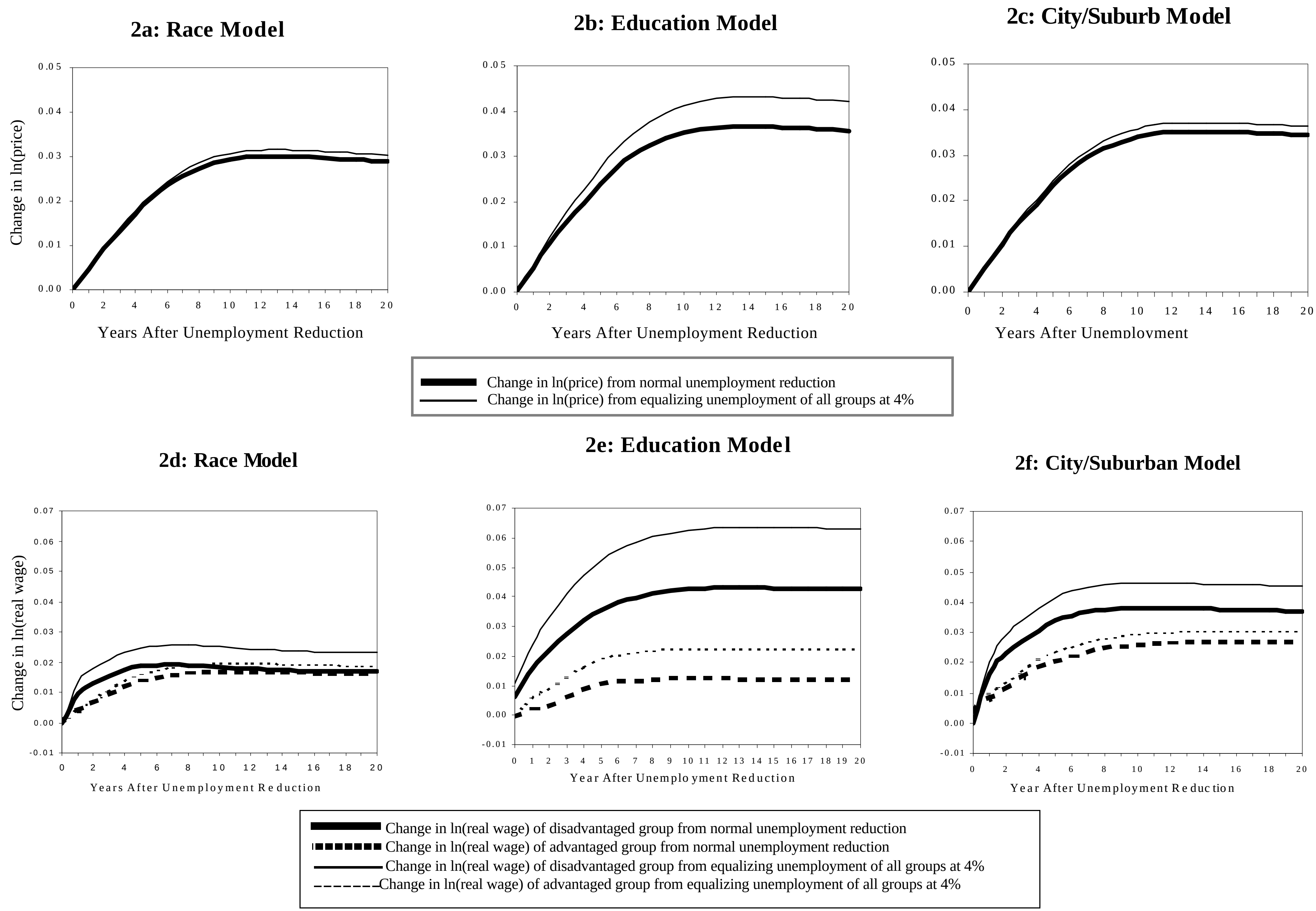


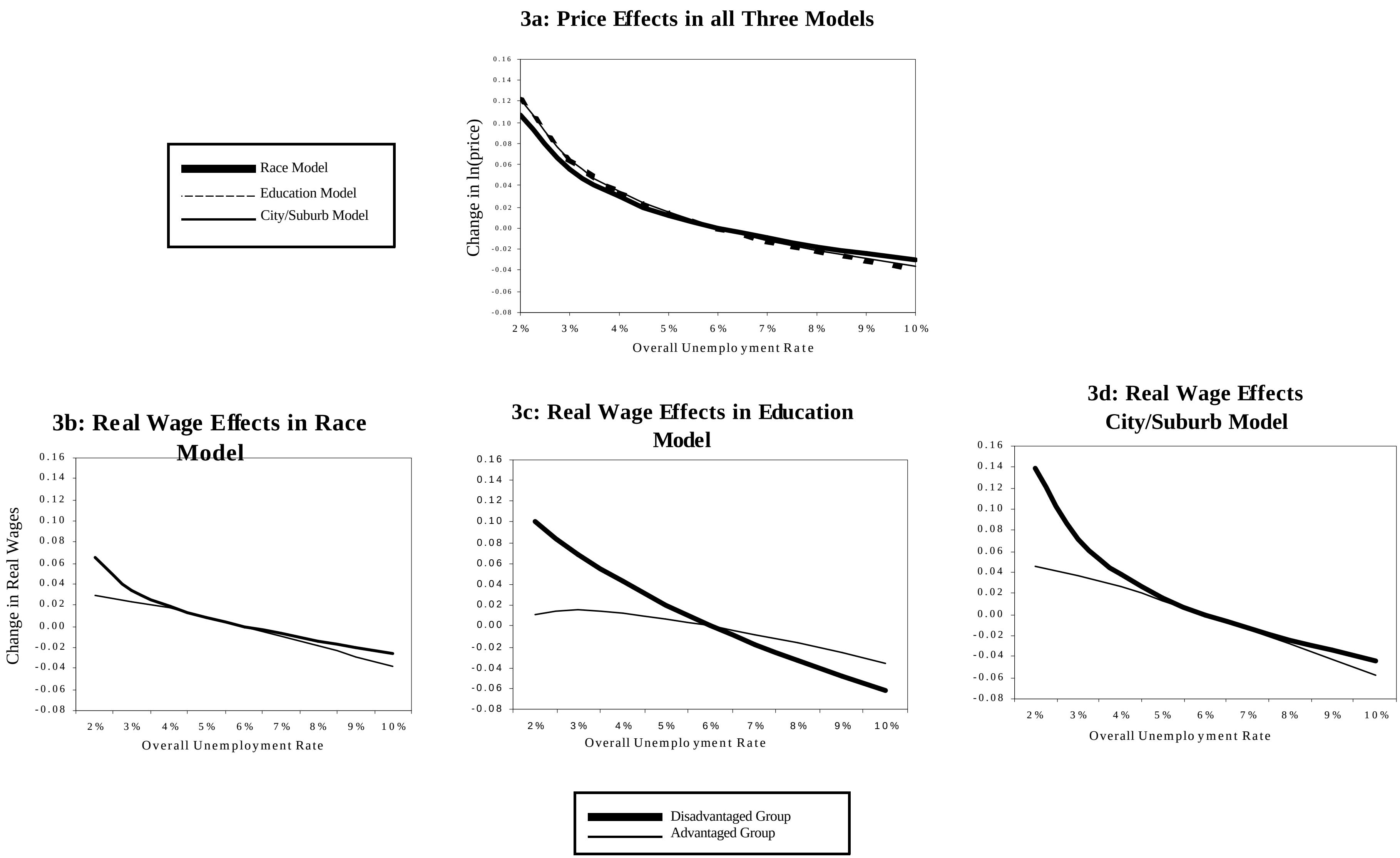
Figure 2: (continued)

Effects on Local Prices and Real Wages After Ten Years of Lowering Unemployment From 6% to 4%, Two Different Ways of Lowering Unemployment: Normal Pattern of Group Unemployment Reductions, and Equalizing Each Group at 4% Unemployment (*t*-statistics in parentheses)

Variables	Model grouping labor market by race (at 6% UR, disadv. UR=9.5%, adv. UR=4.6%)		Model grouping labor market by education (at 6% UR, disadv.=7.3%, adv.=2.7%)		Model grouping labor market by central city/suburban residence (at 6% UR, disadv.=7.9% adv.=4.9%)	
	Normal way of lowering unemployment (disadv.=5.7% adv.=3.3%)	Equalizing both groups at 4%	Normal way of lowering unemployment (disadv.=4.8% adv.=1.9%)	Equalizing both groups at 4%	Normal way of lowering unemployment (disadv.=5.0% adv.=3.4%)	Equalizing both groups at 4%
ln(price)	0.02947 (4.86)	0.03076 (4.67)	0.03528 (5.57)	0.04117 (4.82)	0.03402 (5.52)	0.03583 (5.53)
ln(overall real wage)	0.01734 (2.45)	0.02102 (2.19)	0.03396 (3.79)	0.05093 (2.85)	0.03032 (3.70)	0.03541 (3.74)
ln(real wage disadvantaged group)	0.01837 (1.53)	0.02492 (1.48)	0.04253 (4.05)	0.06233 (2.88)	0.03810 (3.73)	0.04639 (3.88)
ln(real wage advantaged group)	0.01695 (2.75)	0.01956 (2.43)	0.01271 (1.81)	0.02264 (2.07)	0.02613 (2.96)	0.02951 (2.90)

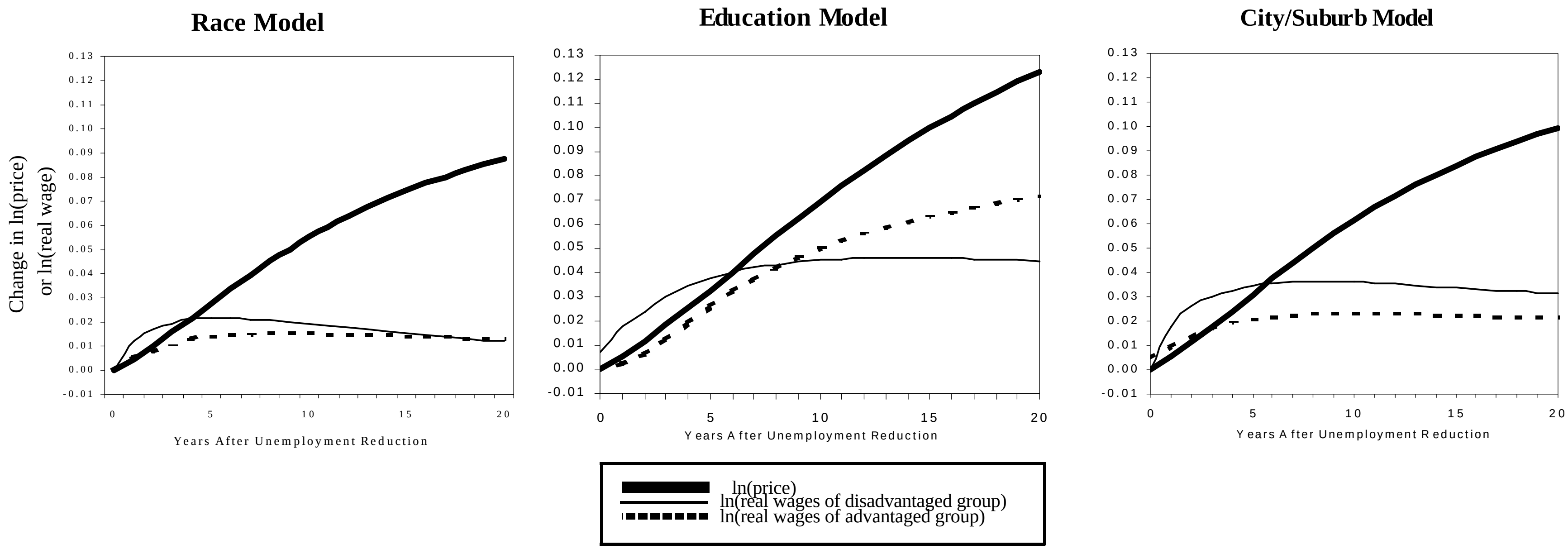
Note: Disadvantaged group/advantaged group are other race/White non-Hispanic for race grouping; less than college graduate/college graduate for education grouping; central city residents/suburban resident fro geographic residence model. In a normal decline in MSA unemployment from 6% to 4%, each group's unemployment declines as described in Table 3. In alternative scenario each group's unemployment changes from 4 percent from whatever it normally is at 6%.

Figure 3: Effect of Normal Variations in Unemployment on Prices and Real Wages



Notes: These estimates are derived from 24 simulations. Eight simulations are done for each of three models. Each simulation starts at six percent overall unemployment, and changes overall unemployment to one of the following unemployment rates: 2%, 3%, 4%, 5%, 7%, 8%, 9%, and 10%. Unemployment rates for each group vary in their normal manner with overall unemployment, as describes in Table 3. Effects reported are ten years after reduction in unemployment, which reflect long- run changes in prices and real wages.

Figure 4: Effects on National Prices and Real Wages of Lowering Unemployment in All MSAs from 6% to 4%, with "Normal" Pattern of Lowering Unemployment Rates of Different Labor Market Groups

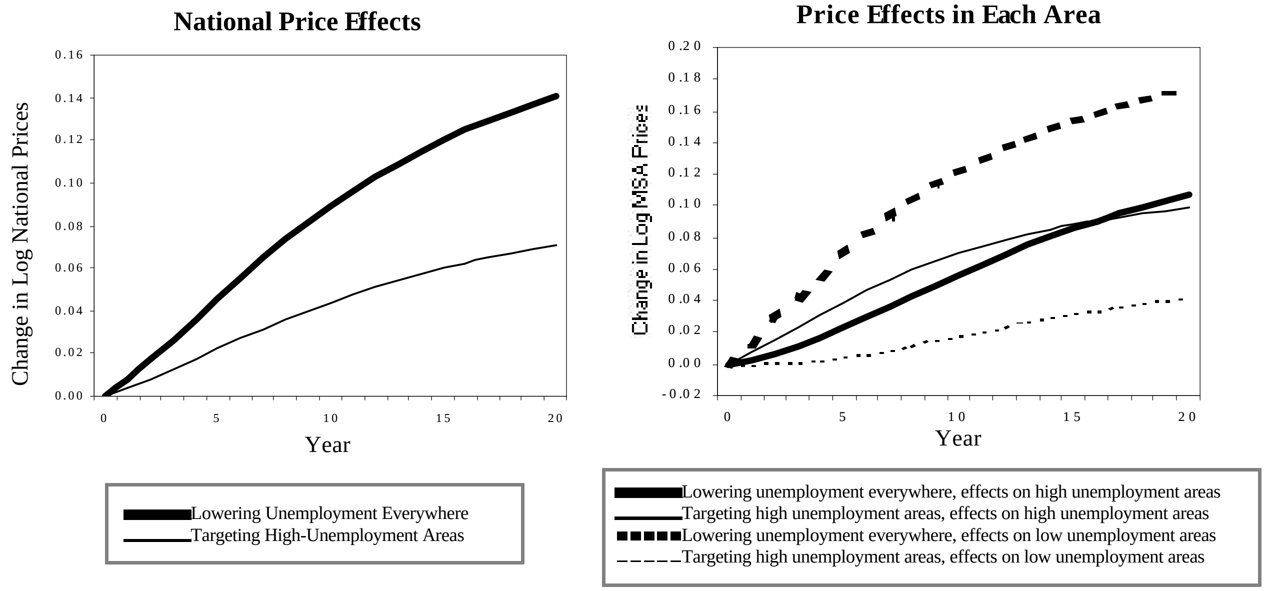


Effects on national (=local) prices and real wages after 10 years of lowering unemployment in all MSAs from 6% to 4%, each group's unemployment declines "normally", using random effects model (*t*-statistics in parentheses)

Variable	Model grouping labor market by race	Model grouping labor market by education	Model grouping labor market by central city/suburban residence
ln(price)	0.05507 (4.57)	0.06938 (5.18)	0.06177 (5.02)
ln(overall real wage)	0.01613 (2.17)	0.04648 (3.19)	0.02751 (3.32)
ln(real wage disadvantaged group)	0.01907 (1.74)	0.04520 (3.87)	0.03581 (3.57)
ln(real wage advantaged group)	0.01502 (2.19)	0.04966 (1.70)	0.02305 (2.68)

Notes: Disadvantaged group/advantaged group are: other race/White non-Hispanic for race grouping; less than college graduate/college graduate for education grouping; central city resident/suburban resident for geographic residence model. In a normal decline in MSA unemployment from 6% to 4%, each group's unemployment declines as described in Table 3. This implies disadvantaged group's unemployment declines more than advantaged group's unemployment declines. Model assumes United States is composed of identical MSAs, each of which experiences an identical unemployment reduction. Estimates based on random effects model, with national variables entered into price and wage equation for college graduates.

Figure 5: Effects on Prices of Two Methods of Lowering National Unemployment: Lowering Unemployment Everywhere, and Targeting High-Unemployment Areas



Notes: These simulations consider imaginary United States that initially is divided into two equal size types of local areas: areas with 8% unemployment, and areas with 4% unemployment, with overall national average unemployment of 6%. The simulations consider two methods of lowering national unemployment from 6% to 4%. Method 1 lowers unemployment everywhere by 2%, changing the high-unemployment areas to 6% and the low-unemployment areas to 2%("Lowering Unemployment Everywhere"). Method 2 lowers unemployment only in high-unemployment areas to 4% ("Targeting High-Unemployment Areas"). All simulations assume that group unemployment in each area changes in normal pattern as unemployment is lowered. Simulations presented here are for model in which groups within MSA are central city residents and suburban residents. Results for other two models are in appendix and are similar.

Estimated Effects after 10 years of Lowering National Unemployment from 6% to 4% (pseudo *t*-statistics in parentheses)

Variable	Method 1: Lowering Unemployment Everywhere	Method 2: Targeting High-Unemployment Areas
ln (national price)	0.09831 (4.81)	0.04995 (5.12)
ln(price in high unemployment areas)	0.06293 (3.67)	0.07998 (6.00)
ln(price in low unemployment areas)	0.13368 (5.24)	0.01993 (2.44)
ln(real wage of central city residents, high-unemployment areas)	0.00972 (0.92)	0.07003 (4.90)
ln(real wage of central city residents, low-unemployment areas)	0.10728 (3.87)	-0.01106 (-2.17)
ln(real wage of suburban residents, high-unemployment areas)	0.01489 (1.41)	0.06049 (4.69)
ln(real wage of suburban residents, low-unemployment areas)	0.01968 (1.10)	-0.01017 (-2.17)

Appendix

This appendix presents some additional results, beyond those discussed in the main text.

Appendix Table A1 presents the coefficient estimates from the three random effects models that are estimated. Figure A1 presents simulations from these three models of the effects of changing national unemployment to various levels, assuming a world in which all local MSAs are identical. Figure A2 presents simulations from this same imaginary world of two different methods of lowering national unemployment, differing in how the unemployment reduction is allocated among different groups. Figure A3 supplements text Figure 5, and presents estimates in the race model and education model of two different methods of lowering national unemployment, differing in whether the unemployment reduction is targeted at high unemployment regions.

Appendix Table A1: Relevant Coefficient Estimates from Final Wage and Price Equation Models, Random National Year Effects

Observations are on MSA/year cell means for variables labor market variables. Each column corresponds to one of the seven equations estimated. Dependent variable for equation is listed at the top. Second row lists functional form for unemployment used on right-hand side of that equation. Subsequent rows list various right-hand side variables and give the estimated coefficients on these RHS variables in each equation, with *t*-statistics in parentheses. All equations also include dummies for each MSA and each year. Last row lists relevant *F*-test probabilities in each equation for variables of a particular type.

	Dependent variables in each of seven equations:						
	Mean ln(wage) of white non-Hispanics in that MSA and year	Mean ln(wage) of other races in that MSA and year	Mean ln(wage) of persons with less than college education in that MSA and year	Mean ln(wage) of college graduates in that MSA and year	Mean ln(wage) of central city residents in that MSA and year	Mean ln(wage) of non-central city residents in that MSA and year	ln(average consumer prices) in that MSA and year
Functional form of unemployment on RHS	UR	1/UR	ln(UR)	UR^2	1/UR	UR	1/UR
Coefficient On:							
Lagged national variable				0.382 (2.82)			0.121 (3.11)
Current UR, group			-0.0278 (-1.44)			0.348 (2.05)	
Lag UR group	0.069 (0.35)	0.000419 (0.49)	-0.0058 (-0.29)	2.464 (0.96)	0.000774 (1.48)	-0.193 (-1.10)	
Current local UR			0.0107 (0.53)			-0.483 (-2.79)	
Lag local UR	-0.536 (-3.03)	0.001665 (1.99)	-0.0235 (-1.11)	-3.492 (-4.30)	0.001979 (3.31)	-0.244 (-1.39)	0.000472 (3.91)
Lag ln(wage group)	0.359 (3.38)	0.219 (4.08)	0.229 (2.38)	0.188 (3.14)	0.323 (5.59)	0.416 (4.59)	
Current wage							0.0644 (4.31)
2nd lag ln(wage group)	-0.162 (-1.50)	-0.068 (-1.22)	0.237 (2.46)	-0.202 (-3.41)	-0.023 (-0.40)	0.069 (0.75)	
lag ln(overall wage)	0.231 (1.94)	0.473 (3.63)	0.449 (4.30)	0.305 (2.76)	0.371 (3.74)	0.229 (2.19)	

Appendix Table 1. (Continued)

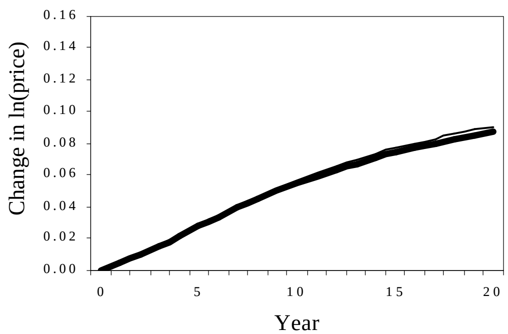
	Dependent variables in each of seven equations:						
	Mean ln(wage) of white non-Hispanics in that MSA and year	Mean ln(wage) of other races in that MSA and year	Mean ln(wage) of persons with less than college education in that MSA and year	Mean ln(wage) of college graduates in that MSA and year	Mean ln(wage) of central city residents in that MSA and year	Mean ln(wage) of non-central city residents in that MSA and year	ln(average consumer prices) in that MSA and year
2nd lag ln(overall wage)	0.263 (2.16)	0.120 (0.90)	-0.129 (-1.20)	0.233 (2.13)	0.057 (0.56)	0.025 (0.24)	
Lag 1 ln(price)	0.368 (3.43)	0.180 (0.75)	0.371 (3.51)	0.037 (0.20)	0.165 (0.99)	0.332 (2.94)	0.978 (22.11)
Lag 2 ln(price)	-0.022 (-0.14)	0.146 (0.43)	-0.092 (-0.61)	0.322 (1.30)	0.067 (0.28)	0.009 (0.05)	-0.246 (-3.99)
Lag 3 ln(price)	0.040 (0.27)	-0.117 (-0.35)	-0.061 (-0.41)	-0.089 (-0.37)	-0.017 (-0.07)	-0.066 (-0.42)	0.074 (1.19)
Lag 4 ln(price)	-0.098 (-0.68)	-0.100 (-0.31)	-0.028 (-0.19)	0.133 (0.57)	0.234 (1.06)	-0.055 (-0.36)	0.082 (1.37)
Lag 5 ln(price)	-0.034 (-0.40)	-0.009 (-0.046)	-0.064 (-0.75)	-0.262 (-1.73)	-0.278 (-2.13)	-0.023 (-0.25)	-0.125 (-3.22)
F-tests probability: All UR variables	0.0001	0.0089	0.0001	0.0001	0.0001	0.0001	0.0001
UR-group	0.7301	0.6225	0.3468	0.3381	0.1409	0.0976	
UR-overall	0.0026	0.0469	0.4793	0.0001	0.0010	0.0009	0.0001
Wage-group	0.0035	0.0003	0.0002	0.0002	0.0001	0.0001	
Wage-overall	0.0002	0.0001	0.0001	0.0001	0.0001	0.0339	0.0001
Prices	0.0001	0.6295	0.0002	0.0712	0.0861	0.0004	0.0001

Note: UR variables are defined as proportions, that is, range between 0.01 and 0.12.

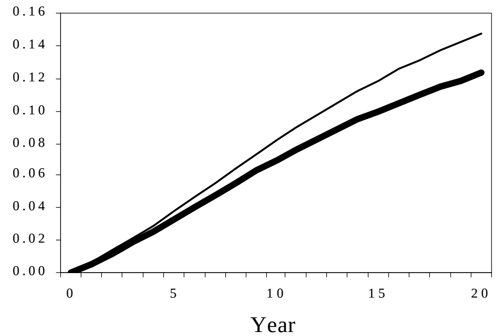
Appendix Figure A2: Price and Wage Effects of Lowering National and Local Unemployment from 6% to 4%, in Three Different Random Effect Models, Using Two Different Patterns of Lowering Unemployment: “Normal” Employment Reductions; Equalizing All Groups’ Unemployment at 4%

Effect on ln(price) in Three Models

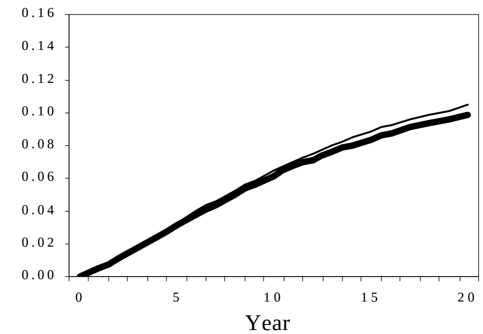
a: Race Model



b: Education Model



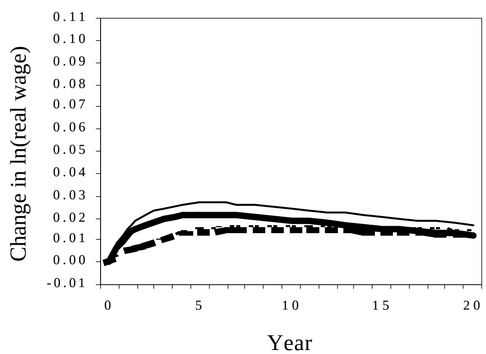
c: City/Suburb Model



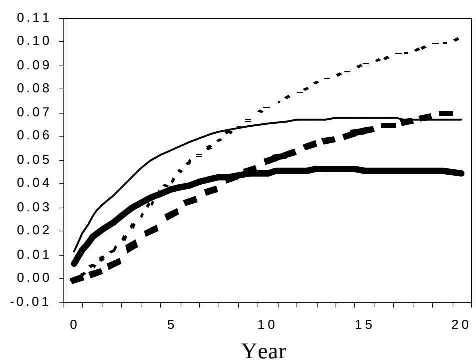
Change in ln(price) from normal unemployment reduction
Change in ln(price) from equalizing unemployment of all groups at 4%

Effect on ln(real wage) in Three Models

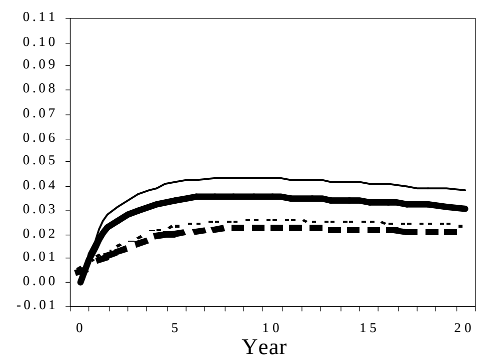
d: Race Model



e: Education Model



f: City/Suburb Model



Change in ln(real wage) of disadvantaged group from normal unemployment reduction
Change in ln(real wage) of advantaged group from normal unemployment reduction
Change in ln(real wage) of disadvantaged group from equalizing unemployment of all groups at 4%
Change in ln(real wage) of advantaged group from equalizing unemployment of all groups at 4%

Figure A2: (continued)

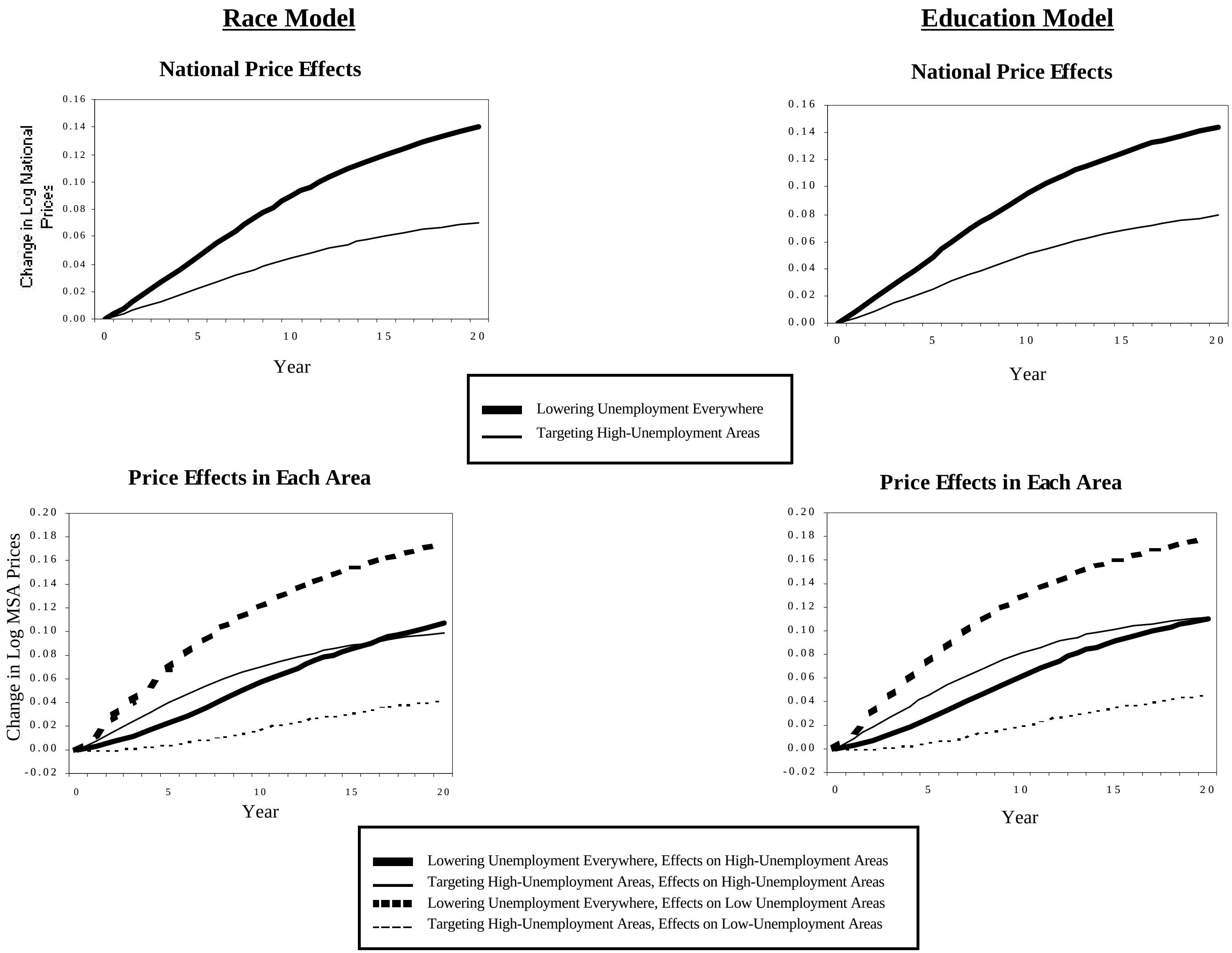
Notes: Figure estimates and table estimates come from estimates of three random effects models. These models are used to simulate effects of lowering national and local unemployment from 6% to 4% in imaginary world in which all MSAs are identical. Two different simulations are considered in each model, one in which unemployment of groups declines normally, the other in which unemployment of all groups is equalized at 4%.

Effects on Local Prices and Real Wages after Ten Years of Lowering Unemployment From 6% to 4%, Two Different Ways of Lowering Unemployment: Normal Pattern of Group Unemployment Reductions, and Equalizing Each Group at 4% Unemployment (t-statistics in parentheses)

Variable	Model grouping labor market by race (at 6% UR, disadv. UR =9.5%, adv.UR=4.6%).		Model grouping labor market by education (at 6% UR, disadv.=7.3%, adv.=2.7%)		Model grouping labor market by central city/suburban residence (at 6% UR, disadv.=7.9%, adv.=4.9%)	
	Normal way of lowering unemployment (disadv.=5.7%, adv.=3.3%)	Equalizing both groups at 4%	Normal way of lowering unemployment (disadv.=4.8%, adv.=1.9%)	Equalizing both groups at 4%	Normal way of lowering unemployment (disadv.=5.0%, adv.=3.4%)	Equalizing both groups at 4%
ln(price)	0.05507 (4.57)	0.05683 (4.42)	0.06938 (5.18)	0.08162 (4.45)	0.06177 (5.02)	0.06492 (5.00)
ln(overall real wage)	0.01613 (2.17)	0.01906 (1.97)	0.04648 (3.19)	0.06790 (2.63)	0.02751 (3.32)	0.03227 (3.51)
ln(real wage disadvantaged group)	0.01907 (1.74)	0.02432 (1.50)	0.04520 (3.87)	0.06599 (2.87)	0.03581 (3.57)	0.04354 (3.70)
ln(real wage advantaged group)	0.01502 (2.19)	0.01708 (2.04)	0.04966 (1.70)	0.07262 (1.67)	0.02305 (2.68)	0.02622 (2.77)

Notes: Disadvantaged group/advantaged group are other race/White non-Hispanic for race grouping; less than college graduate/college graduate for education grouping; central city resident/suburban resident for geographic residence model. In a normal decline in MSA unemployment from 6% to 4%, each group's unemployment declines as described in Table 3. In alternative scenario each group's unemployment changes to 4% from whatever it normally is at 6%.

Figure A3: Effects on Prices of Two Methods of Lowering National Unemployment: Lowering Unemployment Everywhere, and Targeting High-Unemployment Areas, in Race Model and Education Model



Notes: These simulations consider imaginary United States that initially is divided into two equal size types of local areas: areas with 8% unemployment, and areas with 4% unemployment, with overall national average unemployment of 6%. The simulations consider two methods of lowering national unemployment from 6% to 4%. Method 1 lowers unemployment everywhere by 2%, changing the high-unemployment areas to 6% and the low-unemployment areas to 2%("Lowering Unemployment Everywhere"). Method 2 lowers unemployment only in high-unemployment areas to 4% ("Targeting High-Unemployment Areas"). All simulations assume that group unemployment in each area changes in normal pattern as unemployment is lowered. Simulations presented here are for two models: model in which groups within MSA are defined by race, and model in which groups are defined by education level.

Appendix Figure A3: (continued)

Estimated Effects After 10 years of Lowering National Unemployment From 6% to 4% (pseudo *t*-statistics in parentheses), Two Models and Two Methods

	Race Model		Education Model	
Variable	Method 1: Lowering Unemployment Everywhere	Method 2: Targeting High-Unemployment Areas	Method 1: Lowering Unemployment Everywhere	Method 2: Targeting High-Unemployment Areas
ln (national price)	0.08923 (4.29)	0.04409 (4.71)	0.09514 (4.88)	0.05072 (5.27)
ln(price in high-unemployment areas)	0.05656 (3.35)	0.07033 (5.57)	0.06183 (3.75)	0.08133 (6.22)
ln(price in low-unemployment areas)	0.12191 (4.63)	0.01785 (2.31)	0.12845 (5.30)	0.02012 (2.42)
ln(real wage of disadvantaged, high-unemployment areas)	0.00107 (0.10)	0.04369 (2.84)	0.01913 (1.78)	0.08136 (5.19)
ln(real wage of disadvantaged, low- unemployment areas)	0.06004 (1.53)	-0.01030 (-2.01)	0.05744 (2.96)	-0.01099 (-2.26)
ln(real wage of advantaged, high- unemployment areas)	0.00788 (0.90)	0.04178 (4.15)	-0.00577 (-0.46)	0.02157 (1.56)
ln(real wage of advantaged, low- unemployment areas)	0.01387 (0.90)	-0.00830 (-2.11)	-0.01929 (-0.98)	-0.01287 (-2.22)

Note: Disadvantaged/advantaged in race model is “other race”/White non-Hispanic; in education model it is “less than college graduate”/college graduate.

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